



General Certificate of Education

Biology / Biology (Human) 6411 / 6413

Specification A

BYA5 Inheritance, Evolution and Ecosystems

Mark Scheme

2008 examination - January series

For Confidential Packs

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Question 1

- (a) Energy lost (between trophic levels);
Due to movement/ excretion/ respiration/ heat/ faeces/ indigestible/ inedible/
10% is passed on/90% is lost; [*Reject growth*]²
- (b) $\frac{45\,000 \times 0.54}{0.35 \times 0.02}$ or $\frac{45\,000 \times 50 \times 0.54}{0.35}$;

= 3 471 428 tonnes (accept 3 471 xxx); 2
(x = any digit)
(correct answer scores two marks, however derived)
128571.x = 1 mark 6942x = 1 mark 6428xxx = 1 mark

Total 4**Question 2**

- (a) Photolysis; 1
- (b) Excited electrons lose energy;
Along electron transfer chain;
Energy from electrons used to combine ADP and Pi; 3
- (c) Used to reduce GP (to TP)/ donate H/H⁺ to GP; 1

Total 5**Question 3**

- (a) Oxidation;
Of ammonium/ ammonia to nitrate;
Via nitrite;
By nitrifying bacteria / correctly named example; 3 max
- (b) Reduction;
Of nitrates to nitrogen gas;
By denitrifying bacteria; 2 max

Total 5

Question 4

- | | | | |
|-----|------|--|-------|
| (a) | (i) | Oldest / biggest/ four-year-old trees; | 1 |
| | (ii) | Maintains a range of habitats/ not all habitats destroyed;
Species/organisms not lost/ maintains biodiversity; | |
| | | <i>OR</i> | |
| | | Willow plantation is sustainable;
So reduce demands on other woodlands; | |
| | | <i>OR</i> | |
| | | Willow plantation is sustainable/ allows continuous production;
Continuous source of income/energy; | 2 |
| | | | |
| (b) | | Willows take in carbon dioxide;
By photosynthesis;
Little/No net increases in carbon dioxide in atmosphere;
Burning fossil fuels also releases sulphur dioxide; | 3 max |

Total 6

Question 5

- (a) Stores / releases small amount of energy;
Has phosphate that can be transferred to another molecule;
Easily hydrolysed / hydrolysed in a one-step reaction/ one enzyme needed to hydrolyse;
Cannot pass out of cell; 2 max
- (b) (i) Allow ADP and/or Pi to enter;
Allow ATP to leave;
- OR
- One protein allows Pi to pass;
One protein allows ATP and ADP to pass; 2
- ATP, ADP and Pi pass with no reference to direction/wrong direction and no reference to protein/wrong protein = 1 mark*
Reject references to entering/leaving cell
- (ii) ATP cannot be synthesised / cannot leave mitochondria; 1

Total 5**Question 6**

- (a) Measure of the variation of the mean in different samples of the same population/ range of the means; 1
- (b) (i) Condition 2 as for carbohydrates O_2 in = CO_2 out/ RQ = 1; 1
- (ii) RQ is greater than 1;
Anaerobic respiration gives RQ of infinity;
So average/overall RQ is increased;
- OR
- RQ greater than 1;
More CO_2 out than O_2 in;
For some time no O_2 used by yeast 3

Total 5

Question 7

- (a) 1 Homologous chromosomes pair up/ bivalents form;
 2 Crossing over/ chiasmata form;
 3 Produces new combination of **alleles**;
 4 Chromosomes separate;
 5 At random;
 6 Produces varying combinations of chromosomes/ genes/ alleles (*not twice*) ;
 7 Chromatids separated at meiosis II/ later; 6 max
- Independent assortment/ random segregation = marking points 4 and 5*

(b) (i)

Parental phenotypes	Agouti	White	
Parental genotypes	BbAa	bbaa	;
Gamete genotypes	BA Ba bA ba	ba	;
Offspring genotypes	BbAa Bbaa	bbAa bbaa	;
Offspring phenotype	Agouti Black	White White	;

4

*Phenotypes must match genotypes**Allow marking points 2 and 3 if correctly derived from wrong parental genotypes*

(ii)

Colour of offspring	Observed (O)	Expected (E)	(O-E)	(O-E)²	$\frac{(O-E)^2}{E}$
Agouti	34	30	4	16	0.53
Black	35	30	5	25	0.83
White	51	60	9	81	1.35
					$\Sigma \frac{(O-E)^2}{E} = 2.71 \text{ or } 2.72$

;; 2

*(χ^2 correct = 2 marks)**((O-E)² all correct = 1 mark)*

- (ii) p = 0.05;
 2 degrees of freedom;
 Differences due to chance/ no significant difference as χ^2 less than/
 to left of critical value OR Not due to chance/ difference is
 significant as χ^2 greater than to right of critical value; 3

3

(as appropriate for candidates χ^2)

Total 15

Question 8

- (a) (i) Animals share – (**two** of) kingdom, phylum and class; 1
- (ii) Animals do not share – genus and species; 1
- (b) (i) **One** mark for **two** of:
- Addition (insertion) / deletion / substitution / inversion; 1
- (ii) Some involve frameshift/ insertion or deletion of a base;
In frameshift mutation/ named example, all triplets / codons *after point of mutation* altered;
Amino acid sequence changed;
- OR
- Some involve frameshift/ insertion or deletion of a base;
In non-frameshift mutations/ named example only one triplet / codon affected;
May not change amino acid sequence / **code** is degenerate;
(Ignore references to examples)
- OR
- mutations in introns are neutral;
introns non-coding;
removed from mRNA / not used in protein production; 3
- (iii) $q^2 = 0.02$;
 $2pq = 0.24x$ ($x = \text{any digit}$);
Number of heterozygotes = 300 - 304; 3
(correct answer however derived = 3 marks)
($2pq = 0.24x$, however derived = 2 marks)
- (c) (i) Breed animals from different populations, should all produce fertile offspring; 1
- (ii) Different environments/ different selection pressure;
Mutations;
Gene pools become increasingly different;
Leading to reproductive isolation; 3 max
- (iii) Cheetahs are genetically very similar;
As all descended from same group/ few mutations;
OR
Few animals;
Few mutations; 2

Total 15

Question 9

- (a)
- 1 Pioneers / colonisers;
 - 2 Alter the environment / make conditions less harsh;
 - 3 Suitable example – by adding humus to ‘soil’;
 - 4 Allow more / different species to become established;
 - 5 More habitats;
 - 6 Increased biodiversity;
 - 7 **Increase** in complexity of food webs / **increase** stability;
 - 8 Shift from predominance of abiotic factors to biotic factors;
 - 9 Climax reached;
- 5 max
- (b)
- 1 Use of quadrats;
 - 2 Grid created / co-ordinates;
 - 3 Random;
 - 4 From calculator / random number tables / random number generator;
 - 5 Count number in each quadrat;
 - 6 Obtain average;
 - 7 Multiply by area of field;
- 6 max
- (c)
- 1 Obtain sample of the animals and count (N_1);
 - 2 Mark (suitably qualified);
 - 3 Allow time to re-integrate into population;
 - 4 Obtain second sample (N_2) and count number marked (n);
 - 5 Population = $\frac{N_1 \times N_2}{n}$;
- 4 max

Total 15